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DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

LOGISTICAL AMBUSHES
IN
OPERATIONAL TESTING

STUDY PROJECT REPORT
PMC 77-1

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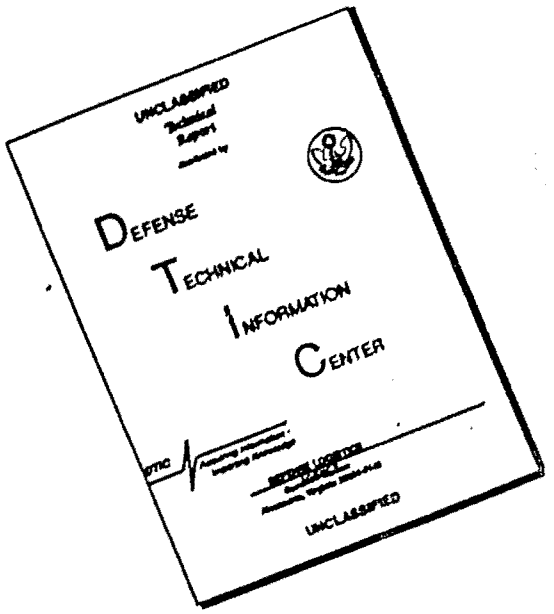

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LOGISTICAL AMBUSHES

IN OPERATIONAL TESTING

Individual Study Program

Study Project Report

Prepared as a Journal Article

Defense Systems Management College

Program Management Course

Class 77-1

by

William Lee Lytle
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May 1977

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): LOGISTICAL AMBUSES IN OPERATIONAL TESTING	5. TYPE OF REPORT & PERIOD COVERED: Study Project Report 77-1
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): WILLIAM L. LYTLE	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: DEFENSE SYSTEMS MANAGEMENT COLLEGE, FT. BELVOIR, VA 22060	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: DEFENSE SYSTEMS MANAGEMENT COLLEGE, FT. BELVOIR, VA 22060	12. REPORT DATE: 77-1
	13. NUMBER OF PAGES: 24
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

UNLIMITED

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

ACCESSION for
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DDC Buff Section ☐
UNANNOUNCED ☐
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE: LOGISTICAL AMBUSHES IN OPERATIONAL TESTING

STUDY PROJECT GOALS:

To identify, define and evaluate certain critical logistical aspects of two major Army weapon system procurements and relate test results to effects upon production or deployment.

STUDY REPORT ABSTRACT:

Logistical deficiencies found in major weapon systems during Operational Testing (OT) are often perceived by a program manager as ambushes. These ambushes may add cost, increased schedule, or modifications to a weapon system.

This article evaluates publications, spares, transportability, tools, test equipment, and ammunition packaging of two major Army weapon system OT. Test data from the M60A2 Tank OT III and the DRAGON antitank weapon system OT III was used as examples of logistical ambushes.

This report evaluated only common logistical ambushes. The author recommends that logistical ambushes may be avoided by the program manager. The use of [illegible] OT [illegible], early [illegible] of logistical aspects of a weapon system, and [illegible] "[illegible]" may not eliminate all logistical ambushes, but will greatly assist in eliminating many common ones.

SUBJECT DESCRIPTORS: Testing and Evaluating

NAME, RANK, SERVICE	CLASS	DATE
[illegible]	PMC 77-1	April 1977

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EXECUTIVE SUMMARY

The results of logistical assessments accomplished during Operational Testing (OT) are often perceived by the program manager as ambushes. These ambushes add cost or increased schedule to the program.

Operational Testing is that testing conducted to estimate the prospective system's military utility, operational effectiveness, operational suitability, or need for modifications. OT is accomplished by units of the type of those expected to use and maintain the system upon deployment. All logistic requirements should be accomplished during OT to assist in evaluating effectiveness and suitability. The results of OT are used to refine logistical estimates, evaluate changes, and insure that a system is acceptable to the user.

This report evaluates certain critical logistical aspects of two major Army weapon systems found during OT. OT reports of the M60A2 tank and the DRAGON Antitank Missile were used to show logistical evaluations and their effects upon production or deployment.

This report also recommends that logistical ambushes may be avoided by the program manager. The use of past OT data to similar systems may not eliminate all ambushes, but will assist in eliminating many surprises.

ACKNOWLEDGEMENTS

The author wishes to express grateful appreciation to LTC Richard B. Major and LTC Bruce Stout, United States Army Operational Test and Evaluation Agency for helpful suggestions and permission to use the logistical data contained in this report. The author ia also indebted to Mr. Donald W. Melton, DAC, Combined Arms Test Activity, for the test data without which this report could not have been written.

TABLE OF CONTENTS

SECTION I

Introduction

Program managers must become more aware of seemingly concealed logistical discrepancies. Many of these hidden logistical problems appear during Operational Tests (OT). OT is the evaluation of a weapon system's effectiveness in a typical using unit. The capabilities of the weapon system and the adequacy of its logistical support are tested by typical soldiers in the Army.

Modern weapons systems must provide a qualitative advantage and the most out of every budget dollar. To meet these challenges all aspects of testing weapons systems must be thorough, especially logistical considerations. Logistical aspects of weapon systems will be of paramount importance on the battlefield of the future (1).

Logistical problem areas that suddenly appear during OT are perceived as ambushes to the program. Logistical ambushes often have an adverse effect upon production or deployment. They add cost, time, or modifications to a system. Data from Selected Acquisition Reports in June of 1970 showed a cost growth of seven percent due to support changes (2).

The article will identify and evaluate certain logistical ambushes that occurred in two major Army Operational Tests. By the use of past OT data future programs may avoid many logistical ambushes. Future programs are considered to be part of the weapons revolution. The weapons revolution has generally increased the difficulties of providing logistical support to combat elements (3). The ever increasing importance of reducing support costs and personnel will require additional emphasis on the front-end of programs for logistical designs in systems. The ever increasing importance upon logistical assessments performed during OT is apparent.

The logistical assessments performed during the M60A2 Tank OT III [illegible] the DRAGON OT III will be utilized to indicate where some logistical [illegible]oushes may be hidden. The M60A2 Tank OT III was an intensified confirmatory troop test conducted by the Modern Army Selected Systems Test, Evaluation and Review (MASSTER) in 1973-1974 (4). The DRAGON Antitank Weapons System OT III was also performed by MASSTER in 1974 (5). The M60A2 tank is a modified M60 tank that incorporates a different turrent, a 152mm main gun that fires conventional ammunition or the Shillelagh missile. The M60A2 tank also has a laser range finder and other modifications to upgrade the system.

The DRAGON Antitank Weapon System is a medium antitank missile. The DRAGON is man-portable and utilizes a command to line-of-sight guided missile automatically guided to target by a tracker which issues electronic commands by a wire link to the missile (6).

The results of these OT provides excellent lessons learned concerning logistical ambushes. The actions taken by the program managers (PM) of these systems was excellent. Logistical support managers in program offices should view these logistical ambushes as they may pertain to their program.

Logistical ambushes are results of items missing or overlooked in the systems Integrated Logistical Support (ILS) plan. The management of this plan is the responsibility of the program manager, who insures that ILS is an integral part of the total development effort (7). The ILS plan of a weapon system normally consists of everything required to support the system.

This report will not cover all logistical aspects assessed during OT. A concentration on certain common logistical ambushes will be focused to indicate production or deployment significance. The logistical aspects selected for this report are publications, spares, transportability, tools, test equipment and ammunition packaging.

SECTION II

Present Practices

There are many decisions that must be made concerning logistical aspects prior to an OT. The major question is what logistical aspects require testing? The next question is how important are these aspects to the total system? These questions must be answered in the OT design plan. The OT design plan is based upon objectives of the test agencies and the deployment plan.

The present practice of OT for major systems places emphasis on demonstrating that all key criteria established can be satisfied including logistic supportability. OT is one of the most fundamental measures of whether or not a system should progress through the acquisition process. When satisfactory results are achieved, tests need not be repeated. When test results reflect significant deficiencies the program is slowed until they are corrected and many times verified by retest.

SECTION III

Study Project Methodology

The methodology used in addressing these logistical ambushes is based upon the extraction of common discrepancies from OT data. This data was compared to logistical support plans envisioned for the systems. The common ambushes were analyzed as to what effects were made upon production or deployment. The PM involved had alternate courses of action in most situations and these decisions are discussed.

The discussion and analysis of the test data also provides information of how some parts of the OT were conducted. The units selected to test a system are normally selected on the basis of how the system will be deployed. A test unit is usually introduced to a new weapon system through publications. Publications support the system by indicating to the operator and maintenance personnel how to operate and maintain it successfully. The system's publications must be clear and accurate. The PM and the logistical test evaluator must work closely when changes are indicated.

SECTION IV

Analysis of the Data

Changes to publications may involve a significant cost to the program. Prior to OT the system's publications are made a portion of the ILS plan. The two weapons systems involved in this analysis had draft publications for their OT. The contractors for both systems were confident that their draft publications were ready for publication.

This confidence was short-lived as the testing progressed. During the M60A2 Tank OT there were 321 comments received concerning publications. The basic complaints by the test units indicated that the technical manuals (TM) were inconsistant, too complicated, could not be understood, and were not routinely followed. The PM grasped the situation early in the OT and upon completion five TMs were completely republished and more than 500 pages were replaced in other manuals.

The test units provided suggested changes to the publications. These suggestions were passed to the PM by the test evaluator. The PM evaluated the changes and passed them to the contractor for incorporation into the publications. Anything from minor changes to complete republishing may be recommended by the test units.

The significance of the M60A2 Tank OT publications results were that the corrections did significantly enhance the tank's acceptability upon deployment. The contractor incorporated the changes into new publications. The contractor had responsibility for the preoperational support and that to continue through early deployment (7). Although the contractor had the responsibility for the publications, a considerable cost was incurred due to the number of changes involved.

During the DRAGON OT thirty-three proposed publication changes were submitted by the test units. All changes were reviewed by the DRAGON PM and forwarded to the contractor. The DRAGON contractor had preoperational support responsibilities similar to those of the M60A2 tank contractor. The publications proposed for the DRAGON were found adequate, however the changes incorporated did assist in the operation of the system. The changes submitted by maintenance personnel during the test related to simple imporvements and overall lower life-cycle costs.

When comparing the number of changes per each test there appears to be little significance in the DRAGON results. The number of M60A2 tanks deployed is several hundred. The number of DRAGON missiles employed is in the thousands. The comparison may be better explained by the relatively few tank battalions involved with the M60A2 tank as with all infantry and mechanized infantry battalions in the Army involved with the DRAGON missile.

The publication changes made during and after the DRAGON OT assisted in the acceptability of the system by the individual soldier. This in turn resulted in better deployment acceptability and confidence by the units concerned.

Preoperational support to include operation and maintenance publications by contractors proved to be an effective method of handling publication changes for both systems. The program managers could have published the manuals prior to OT, but both used test results to insure better publications and thus better acceptability of their programs.

The second most common logistical ambush shown by the test data used was spare parts stockage. Both systems had anticipated and stocked spares according to support plans envisioned by the PM. Spare parts are one of the most expensive elements of the ILS (1).

Prescribed Load List (PLL), unit spares, and Authorized Stockage List (ASL), support unit spares, will not be finalized by testing, however base data is usually extrapolated and used in the initial deployment spares plan. Normally, the longer the testing period the better the spare parts data will be. During OT all repair parts ordered and used by the test units must be recorded and analysed.

During the M60A2 Tank OT, 243 PLL line items had three or more demands during a 180 day period, thus qualifying them for stockage. A complete demand history was established for 2,890 requisitions submitted

during the OT. The proposed spares were exceeded for both PLL and ASL. The most significant cost increases were in the ASL. These additional spares consisted of high cost items such as wiring harness, gear boxes, roller bearings, converters, and electrical relay panels.

The PM and the contractor approached the spares ambush jointly. The PM did revise his initial spares plan to include additional items. The contractor made improvements to many parts as a result of the OT. Improvements were made on the turrent traverse gear box, generator control box, in-battery switch for the main gun, missile trackers, and laser range finder. The spares ambush was solved, but at a considerable expense to the program.

The PM had many courses of action on the spares ambush. He could have deployed the system with the initial spares plan or with additional spares as indicated by the OT. The production of additional spares and the improvements made on the system prior to deployment did effect both production and deployment.

During the DRAGON OT less spare line items were utilized than anticipated by the PM logistical support plan. The line items utilized were primarily high cost items. The PM had estimated spares for the first year of operation of $1.5 million (6). Test results indicated that this figure was considerably short of what would actually be required. The contractor was also required to make certain fixes and harden several

parts, especially in the tracker. These costs, in turn, did adversely affect the deployment. The DRAGON PM could have used his initial spares plan or used a modified spares plan indicated by the OT. The adoption of a modified spares plan and system improvements did provide for a more acceptable system to the user.

The next ambush that is often overlooked until it is put into actual use is the systems transportability. Both systems were transportable, however both had stated that existing combat loads would be utilized. Since ammunition and other required support are in the combat unit's basic load these must be addressed during OT. Both systems had an impact on total transportation requirements.

During the M60A2 Tank OT the unit transportation section did not have the capability to support the unit with the existing basic load. The basic problem related to cubage required for the ammunition rather than weight. Information received from previous testing indicated that paper exercises had been used concerning weight to be transported. The cubage of the 152MM ammunition and Shillelagh missiles was three times that found in a M60 tank battalion.

The PM and the user resolved this ambush by a reduction of the ammunition basic load. This was accomplished based on the fact that the main gun was more accurate at longer ranges. Department of the Army Headquarters also stated that no additional transportation vehicles would be assigned.

The DRAGON OT had similar results. The ammunition basic load data received from the user reflected a requirement for 836 additional cubic feet of cargo space. This increased cubage came from the facts that the DRAGON missile replaced the 90mm coilless rifle in the infantry battalion. The 90mm ammunition is boxed two rounds per case at 1.21 cubic feet per box. The DRAGON missile is seven cubic feet boxed. Based on this information and test results the test unit requested additional cargo vehicles to transport their basic ammunition load.

A new basic load was computed by the user to effectively utilize the assigned transportation. The increased effectiveness of the DRAGON missile over the 90mm recoilless rifle indicated that a significant reduction in the number of rounds could be accomplished. As with the M60A2 tank battalion, guidance from the Department of the Army stated that no additional cargo vehicles would be assigned.

The increased cubage of modern weapons systems must be addressed as soon as possible by the PM. An impact on transportation from the battlefield to the manufacturer must be addressed. This quickly becomes a tri-service ambush. The increased effectiveness of these systems may offset the number of systems or rounds of ammunition, but this reduction is generally subjective. The logistics manager of a program must think total system, not just tank or missile. Deployment doctrine must be considered for the total system support plan.

The next common ambush relates to tools, testing, and diagnostic equipment. Tools, testing, and diagnostic equipment required for the operation, maintenance, and training were placed in the test units according to their logistical support plans and deployment doctrine.

The M60A2 Tank OT results indicated that no serious operational limitations were due to support-planned tools. Twelve additional tools were recommended by the test unit. Three additional tools were recommended by the direct support maintenance unit and two tools by the general support maintenance unit.

These tools were recommended primarily due to the compactness of the turrent, lack of working space, and special requirements (such as torqueing of some bolts and screws). The introduction of a tool does not appear to be significant, however when the number of maintenance sections and mechanics requiring these additional tools are analyzed a considerable cost is incurred by the program. Most of the tools recommended were adopted and this resulted in significant deployment and life-cycle costs.

Tools required for operation and maintenance can be verified by use data, authorization documents, and work requests. The PM has few alternatives when the required maintenance indicate a new tool is necessary. The M60A2 Tank OT results indicated that existing, but not authorized in the support plan, tools were required.

The test and diagnostic equipment proposed for deployment of the

M60A2 tank lacked the capability to isolate malfunctions, and maintenance personnel were forced to replace defective components by trial and error. The test units desired a fault isolation test set similar to those used by automobile companies. The test unit's request for a "plug-in," print out of faults test set was a new requirement for the system.

The feasibility of a complete fault isolation test set was analyzed by the PM and the contractor. The cost of a "plug-in" type fault isolation test set was found too risk prone and far too expensive. The test sets utilized during the test were improved to assist in diagnostic capability, particularly in fault isolation. The costs of the improvements to the turrent electrical and stabilization test sets were significant. These costs were charged to the M60A2 tank program.

The DRAGON OT results indicated less tools than the M60A2 tank OT. The test unit and the direct support maintenance unit desired six additional tools be placed in the support plan. The addition of only six tools appears insignificant, however three tools were added to each infantry or mechanized infantry battalion and three to each direct support maintenance battalion per division.

The costs of these tools was not charged directly to the DRAGON program as the tools required were available in current supply catalogs. The tools required did add to the total life-cycle cost of the system. Operation and maintenance funds were utilized for the tool purchases.

Direct support maintenance personnel were credited with a labor saving test set for the Launch Effects Trainer (LET). This trainer simulates firing the DRAGON during training. Two direct support maintenance personnel designed a LET test set to improve electrical repair procedures. This device will save many man hours for future repairmen. In OT this is called a side benefit from the "wringing out" process. This side benefit is shown so that the reader may realize that not all results of OT are ambushes to a system. Many side benefits result by giving the system to the soldiers and letting them find a better or easier way to keep it operating.

The "wringing out" process provides an excellent basis for determining acceptance of logistical support plans. Unlike the M60A2 tank test sets the DRAGON Tracker Test Set was found to be an excellent piece of equipment. Maintenance personnel were required to have special training for its use, but it was well received.

The last ambush for analysis in this report is the system's ammunition evaluation. Ammunition storage and containerization must be evaluated with the system during OT. Both the M60A2 tank and the DRAGON utilize missiles. During the M60A2 Tank OT, rearming and refueling exercises were performed by selected tank platoons. The Shillelagh missile container had been changed to strenghten the metal bands. The new bands on the container were thicker than normal banding material. When the support element of the test unit gave the missiles (in containers) to the

tank platoons a problem arose as to how to get the missile out of the container. Since each tank has an ax as a basic issue item and the tank crews knowing they were being evaluated on the exercises, the crew quickly broke the bands with axes. All concerned were happy to note that inert missiles were used in the exercises.

To assist the tank crews a heavy duty band cutter was provided for each tank. This cost was not charged to the M60A2 tank program. The band cutters utilized were stocked items, but the cost of band cutters for over 500 tanks did add to the total life-cycle costs. The band cutters also made the system more acceptable for deployment.

The PM and the logistic manager must be aware of all changes to any part of their system. Just as the small change of an ammunition container's band thickness could have caused a negative attitude by the user of the system.

The DRAGON missile containers were similar to the Shillelagh, except that the container tops were nailed down instead of being hinged. During the DRAGON OT over 200 missiles were fired and the ammunition personnel received numerous evaluations. The ammunition personnel stated that the DRAGON missile container tops should be hinged instead of nailed down since the exposed nails were a safety hazard.

The weight and cube of DRAGON missiles in containers caused some difficulty in handling and storage. The weight and cube problems were

addressed by the PM and contractor, but nothing could be done in this area as these problems were found to be inherent with the missiles. The missile container tops did present a minor safety hazard.

The missile containers of the entire first production procurement were not changed as they had been received by the Army. The PM suggested that the second procurement would consider the use of wire hinges instead of nail down tops. This minor change to the missile container does not appear significant, but a considerable cost will be added to the DRAGON program as the change will affect thousands of containers. This change will make the system more acceptable for future deployment, but has added cost to the production.

SECTION V

Summary

Logistical ambushes that suddenly appear during OT can be avoided. They should not be surprises to the PM or his logistics manager. There are positive steps that can and should be taken to avoid surprises like the ones shown in this report. The first step is studying logistical lessons learned from similar OT or other logistical data. Many PM and their logistics managers envision their programs as a one of a kind and has no comparison. The Army Operational Test and Evaluation Agency has a wealth of data concerning fielded systems. This data provides excellent lessons learned and should be utilized.

The second step is to identify logistical aspects of a system as early as possible in the acquisition cycle. A broad conceptual support plan should be envisioned for Milestone 0. The early identification of logistical aspects of the system will assist in the last step of ambush avoidance.

The last step is conducting "What If Exercises" concerning logistical aspects throughout the acquisition cycle. The following "What If Exercises" provide a few examples of how ambushes may be recognized: What if the spares are insufficient? What if the transportability of any

part of the system is changed? What if more tools are required? What if the test equipment is unsatisfactory for troop use? What if the system's ammunition causes problems? What if the publications cannot be understood by the troops?

The three steps above are not a cure all for logistical ambushes, but they will assist in eliminating many of the common ones. Avoiding logistical ambushes will greatly assist the PM in providing a better system to the user.

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6. Guided Missile System, Surface Attack: M47 DRAGON Weapon System, Logistical Support Plan, January 1974.
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This regulation defines the integrated logistics support (ILS) and determines who is responsible for its implementation in program management. This regulation also suggests the use of preoperational support for major systems to achieve stability.